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National Food Safety and Toxicology Center

Scoring & Ranking Assessment Model (SCRAM)

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Version 9: Updated February 2, 2000

ENVIRONMENTAL SCIENCE AND POLLUTION RESEARCH INTERNATIONAL

Background information and instructions related to the use of SCRAM have been published as a series of four journal articles. You may download PDF files of these articles, courtesy of the publisher of *Environmental Science & Pollution Research (ESPR)* *Ecomed Publishers*, D-86899 Landsberg. Germany.

The web sites to obtain the four published articles are:
Environ. Sci. & Pollut. Res., Vol. 7, 2000
ESPR No. 1) http://dx.doi.org/10.1065/espr199910.009
ESPR No. 2) http://dx.doi.org/10.1065/espr199910.010
ESPR No. 3) http://dx.doi.org/10.1065/espr199910.011
ESPR No. 4) http://dx.doi.org/10.1065/espr199910.012

User name:	
Date:	
Chemical name:	
CAS number:	

Final Chemical Score:	Final Uncertainty Score:	Final Composite Score:
0	0	0

START::::::::::::

BIOACCUMULATION

The following types of data are acceptable for scoring bioaccumulation: measured BAF, measured BCF, Kow, estimated BAF, estimated BCF. They are listed in order of preference, with greater preference and lesser uncertainty scores given to those listed first.

BCF, BAF, Kow	Score Values
> 100,000	5
> 10,000 to 100,000	4
> 1000 to 10,000	3
> 100 to 1000	2
< or = 100	1

Data types are listed below with their associated uncertainty scores. Enter the uncertainty score into the yellow box (cell C80) below next to "Uncertainty Score." Enter the score from the yellow box above into the yellow box below (cell C79) next to "Chemical Score."

Uncertainty Scores	
Measured BAF	0
Measured BCF	1
Kow	2
Estimated BAF	4
Estimated BCF	5

Bioaccumulation Scores	
Chemical Score:	
Uncertainty Score:	

Go to Environmental Persistence

ENVIRONMENTAL PERSISTENCE

Half-life in Biota	Half-life in Air	Half-life in Soil	Half-life in Sediment	Half-life in Water	Score Values
> 100 days	> 100 days	> 100 days	> 100 days	> 100 days	5
> 50 to 100 days	> 50 to 100 days	> 50 to 100 days	> 50 to 100 days	> 50 to 100 days	4
> 20 to 50 days	> 20 to 50 days	> 20 to 50 days	> 20 to 50 days	> 20 to 50 days	3
4 to 20 days	4 to 20 days	4 to 20 days	4 to 20 days	4 to 20 days	2
< 4 days	< 4 days	< 4 days	< 4 days	< 4 days	1

A half-life value is required for each subcategory. If a value is not available for a particular subcategory, go to a multi-media model to estimate the half-life. Determine a score for each subcategory. Then record the single greatest score among the five subcategories into the yellow score box below next to "Chemical Score" (cell C118). One uncertainty point is assessed for each subcategory in which an estimated value is used, and two points for each category for which no value is available, for a possible total of ten uncertainty points. Enter the uncertainty score in the yellow box below next to "Uncertainty Score" (cell C119).

Environmental Persistence Scores	
Chemical Score:	
Uncertainty Score:	

If the Chemical Score is 1 or 2, go to ACUTE TOXICITY. If no Chemical Score is available for any of the subcategories, or if the Chemical Score is 3, 4, or 5, go to CHRONIC TOXICITY.

If the chemical is not persistent, is there continuous environmental loading? Are there any significant metabolites? Score them as as well.

ACUTE TERRESTRIAL TOXICITY

Plants	Mammals	Herps	Birds	Invertebrates	Score Values
ED50 or LD50 (kg/ha or lb/acre)	Oral ED50 or LD50 (mg/kg/d)	Oral ED50 or LD50 (mg/kg/d)	Oral ED50 or LD50 (mg/kg/d)	ED50 or LD50 (mg/kg)	
< or = 0.1	< or = 5	< or = 5	< or = 5	< or = 5	5
> 0.1 to 1	> 5 to 50	> 5 to 50	> 5 to 50	> 5 to 50	4
> 1 to 10	> 50 to 500	> 50 to 500	> 50 to 500	> 50 to 500	3
> 10 to 100	> 500 to 5000	> 500 to 5000	> 500 to 5000	> 500 to 5000	2
> 100	> 5000	> 5000	> 5000	> 5000	1

A toxicity score is required for each subcategory in the yellow box above. Determine a score for each subcategory, then record the single greatest score among the five subcategories in the yellow score box below next to "Chemical Score" (C168). An uncertainty point is assigned for each subcategory for which no toxicity value is available, for a possible total of five uncertainty points. Enter the uncertainty points in the yellow box below, next to "Uncertainty Score" (C169).

Acute Terrestrial Toxicity Scores	
Chemical Score:	
Uncertainty Score:	
Composite Score:	0

ACUTE AQUATIC TOXICITY

Plants	Amphibians	Warm Water Fish	Cold Water Fish	Invertebrates	Score Values
EC50 or LC50 (mg/L)	EC50 or LC50 (mg/L)	EC50 or LC50 (mg/L)	EC50 or LC50 (mg/L)	EC50 or LC50 (mg/L)	
< or = 1	< or = 1	< or = 1	< or = 1	< or = 1	5
> 1 to 10	> 1 to 10	> 1 to 10	> 1 to 10	> 1 to 10	4
> 10 to 100	> 10 to 100	> 10 to 100	> 10 to 100	> 10 to 100	3
> 100 to 1000	> 100 to 1000	> 100 to 1000	> 100 to 1000	> 100 to 1000	2
> 1000	> 1000	> 1000	> 1000	> 1000	1

A toxicity score is required for each subcategory in the yellow box above. Determine a score for each subcategory, then record the single greatest score among the five subcategories in the yellow score box below next to "Chemical Score" (C202) An uncertainty point is assigned for each subcategory for which no toxicity value is available, for a possible total of five uncertainty points. Enter the uncertainty points in the yellow box below, next to "Uncertainty Score" (C203).

Acute Aquatic Toxicity Scores	
Chemical Score:	
Uncertainty Score:	
Composite Score:	0

Total Acute Toxicity = Acute Terrestrial Toxicity + Acute Aquatic Toxicity

Total Acute Toxicity Scores	
Chemical Score:	0
Uncertainty Score:	0
Composite Score:	0

STOP. Go to FINAL SCORES.
See the Navigator in LOTUS.

SUBCHRONIC/ CHRONIC TERRESTRIAL TOXICITY

All terrestrial chronic toxicity LO(A)EL values should be corrected with a severity factor. Multiply the LO(A)EL (mg/kg/d) by 0.1 for severe effects or by 0.3 for moderate effects. Then score the chemical by using the corrected LO(A)EL. Where a LO(A)EL and NO(A)EL are both available from the same study, the NO(A)EL is preferred. If NO(A)EL or LO(A)EL values are available from different studies for the same category, the least value is preferred.

Plants	Mammals *		Reptiles and Amphibians (Herps) *		Birds*		Invertebrates	Score Values
LO(A)EL or NO(A)EL	LO(A)EL	> or = 90 d NO(A)EL	LO(A)EL	> or = 90 d NO(A)EL	LO(A)EL	> or = 90 d NO(A)EL	LO(A)EL or NO(A)EL	

(kg/ha or lb/acre)	(mg/kg/d)	(mg/kg/d)	(mg/kg/d)	(mg/kg/d)	(mg/kg/d)	(mg/kg/d)	(mg/kg)	
< or = 0.1	< or = 10	< or = 1	< or = 10	< or = 1	< or = 10	< or = 1	< or = 10	5
> 0.1 to 1	> 10 to 100	> 1 to 10	> 10 to 100	> 1 to 10	> 10 to 100	> 1 to 10	> 10 to 100	4
> 1 to 10	> 100 to 1000	> 10 to 100	> 100 to 1000	> 10 to 100	> 100 to 1000	> 10 to 100	> 100 to 1000	3
> 10 to 100	> 1000 to 5000	> 100 to 1000	> 1000 to 5000	> 100 to 1000	> 1000 to 5000	> 100 to 1000	> 1000 to 5000	2
> 100	> 5000	> 1000	> 5000	> 1000	> 5000	> 1000	> 5000	1

A toxicity score is required for each subcategory in the yellow box above. Determine a score for each subcategory, then record the single greatest score among the five subcategories in the yellow score box below next to "Chemical Score" (C263). An uncertainty point is assigned for each subcategory for which no toxicity value is available, for a possible total of five uncertainty points. Enter the uncertainty points in the yellow box below, next to "Uncertainty Score" (C264).

Chronic Terrestrial Toxicity Scores	
Chemical Score:	
Uncertainty Score:	
Composite Score:	0

* NOTE: When studies of > or = 90 days are not available, repeated-dose studies of lesser duration (> or = 28 days) may be used. For these shorter term studies, criteria dosage levels for scoring should be increased by a factor of 3 unless data indicate that steady state test conditions (equilibrium) have been reached and the expected critical effect may be adequately evaluated from exposures of less than 90 days.

SUBCHRONIC/ CHRONIC AQUATIC TOXICITY

Plants	Amphibians	Warm Water Fish	Cold Water Fish	Invertebrates	Score Values
MATC, NOEC, LOEC (mg/L)	MATC, NOEC, LOEC (mg/L)	MATC, NOEC, LOEC (mg/L)	MATC, NOEC, LOEC (mg/L)	MATC, NOEC, LOEC (mg/L)	
< or = 0.1	< or = 0.1	< or = 0.1	< or = 0.1	< or = 10	5
> 0.1 to 1	> 0.1 to 1	> 0.1 to 1	> 0.1 to 1	> 10 to 100	4
> 1 to 10	> 1 to 10	> 1 to 10	> 1 to 10	> 100 to 1000	3
> 10 to 100	> 10 to 100	> 10 to 100	> 10 to 100	> 1000 to 5000	2
> 100	> 100	> 100	> 100	> 5000	1

A toxicity score is required for each subcategory in the yellow box above. Determine a score for each subcategory, then record the single greatest score among the five subcategories in the yellow score box below next to "Chemical Score" (C300). An uncertainty point is assigned for each subcategory for which no toxicity value is available, for a possible total of five uncertainty points. Enter the uncertainty points in the yellow box below, next to "Uncertainty Score" (C301).

Chronic Aquatic Toxicity Scores	
Chemical Score:	
Uncertainty Score:	
Composite Score:	0

SUBCHRONIC/ CHRONIC HUMAN TOXICITY

Includes human epidemiological data and established rodent and simian test protocol data. All other test data will be scored under subchronic / chronic terrestrial toxicity. All LO(A)EL values should be corrected with a severity factor. Multiply the LO(A)EL (mg/kg/d) by 0.1 for severe effects and by 0.3 for moderate effects. Then score the chemical by using the corrected LO(A)EL. Where LO(A)EL and NO(A)EL are both available from the same study, use the NO(A)EL.

General Toxicity *		Reproductive Toxicity		Developmental Toxicity		Carcinogenicity **	Other Toxicity ***	Score Values
LO(A)EL (mg/kg/d)	> or = 90 d NO(A)EL (mg/kg/d)	LO(A)EL (mg/kg/d)	> or = 90 d NO(A)EL (mg/kg/d)	LO(A)EL (mg/kg/d)	> or = 90 d NO(A)EL (mg/kg/d)	(mg/kg/d)	(mg/kg/d)	
< or = 10	< or = 1	< or = 10	< or = 1	< or = 10	< or = 1	See Calculations	See Calculations	5
> 10 to 100	> 1 to 10	> 10 to 100	> 1 to 10	> 10 to 100	> 1 to 10	Box	Box and Definition	4
> 100 to 1000	> 10 to 100	> 100 to 1000	> 10 to 100	> 100 to 1000	> 10 to 100	Below	Below	3
> 1000 to 5000	> 100 to 1000	> 1000 to 5000	> 100 to 1000	> 1000 to 5000	> 100 to 1000			2
> 5000	> 1000	> 5000	> 1000	> 5000	> 1000			1

A toxicity score is required for each subcategory in the yellow box above except for the "Other Toxicity" subcategory. Determine a score for each subcategory, then record the single greatest score among the five subcategories in the yellow score box below next to "Chemical Score" (C394). An uncertainty point is assigned for each subcategory (except for "Other Toxicity") for which no toxicity value is available, for a possible total of four uncertainty points. Enter the uncertainty points in the yellow box below, next to "Uncertainty Score" (C395).

* GENERAL TOXICITY: General organ system toxicity, i.e. hepatotoxicity, neurotoxicity, renal toxicity, etc.

*** OTHER TOXICITY: Effects such as mutagenicity, immunotoxicity, endocrine system effects, etc. Where well-established test protocols may be lacking, where the level of test data is minimal, where whole animal test data are not readily available and predictive *in vitro* -type assay data must be considered *in lieu* of whole animal assays. Score values may be assigned based on narrative definition or description. See the sample calculation box below.

NOTE: Lack of data in the "OTHER TOXICITY" category will NOT generate an uncertainty score for the subcategory. Instead, the subcategory acts as a modifier to the total toxicity score.

STUDY DURATION: When studies of > or = 90 days are not available, repeated-dose studies of lesser duration (> or = 28 days) may be used. For these shorter term studies, criteria dosage levels for scoring should be decreased by a factor of three unless data indicate that steady state test conditions (equilibrium) have been reached and the expected critical effect can be evaluated adequately from exposures of less than 90 days.

Alternatively, the user may elect to follow the Ontario MOEE Scoring System adjustment for study duration as follows:
=> 28-89 days, multiply the criteria dosage levels by a factor of 0.1
=> repeated doses for < 28 days, multiply the criteria dosage levels by 0.01

Other Toxicity Calculations Box:

Mutagenicity	Behavioral Effects	Immune System Effects	Endocrine Effects	Score Values
Positive germ line	Severe-Irreversible	Severe-Irreversible		5
Possible germ line	Severe-Reversible or Moderate-Irreversible	Severe-Reversible or Moderate-Irreversible		4
Positive somatic line	Moderate-Reversible	Moderate-Reversible	High Potential	3
Possible somatic line	Slight Effects	Slight Effects	Moderate Potential	2
No known mutagenic effects	No Known Effects	No Known Effects	Low Potential	1

Carcinogenicity Calculations Box:

** For the carcinogenicity category, multiply the 1/ ED10 value by the weight of evidence value (USEPA proposed classification).

"known human carcinogen" = 3, "likely human carcinogen" = 2, and "suggestive evidence for carcinogenicity" or "conflicting data" = 1

Then use the corrected value as the 1/ ED10 to score the chemical.

1/ ED10 **** (mg/kg/d)	Score Values
> 45	5
> 15 to 45	4
> 5 to 15	3
> 1.5 to 5	2
< or = 1.5	1

Return to CHRONIC HUMAN TOXICITY. See the Navigator in LOTUS.

Chronic Human Toxicity Scores	
Chemical Score:	

Uncertainty Score:	
Composite Score:	0

Total Chronic Toxicity =
Chronic Terrestrial Toxicity + Chronic Aquatic Toxicity + Chronic Human Toxicity

Total Chronic Toxicity Scores	
Chemical Score:	
Uncertainty Score	
Composite Score:	0

STOP. Go to FINAL SCORES.
See the Navigator in LOTUS.

FINAL SCORES

Chemical Score:	0
Uncertainty Score:	0
Composite Score:	0